



The Scope, Timing, and Type of Corruption

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This paper provides an analysis of the corruption problem in public organizations. It distinguishes between two types of corruption (individual/organized) and crime (bribe for a legal/illegal application), and between two occasions (before/after detection) for partial and full collusion. The integrated supervision procedure, where monitoring and review are centralized, displays higher individual corruption but a lower risk of organized corruption than the alternative, separated supervision procedure. Higher penalties and bribes, and lower rewards to supervisors, increase the risk of all types of collusion under both procedures. A trade-off is involved in the choice of the supervision procedure and penalties: Reducing individual corruption brings about a higher risk of organized corruption. © 1998 by Elsevier Science Inc.

I. Introduction

Corruption is a complex, multidimensional phenomenon. It can be manifest at the individual level as an isolated event and at the group level in an organized and systematized form. It can involve various types of crimes ranging from the trivial acceptance of "speed money" to the illegal sale of land by government officials administering a land reform. An organization may display partial collusion, as supervisors may be internally bribed to cover up a specific type of crime upon its detection. Determinants of individual corrupt incentives are the size of the private benefit, the structure of the organization, its rules, distribution of tasks, and review procedures. Many social scientists have acknowledged the importance of organizational and economic influences, but few (some of whom are mentioned below) have examined these factors formally. The lack of satisfactory formal models of public bureaucracies and supervision procedures impedes our understanding of the many organizational aspects of corruption. The present paper takes a step in this direction.

What is the relationship between supervision procedures and the level, type, and scope of corruption? How effective are sanctions and rewards to successful supervision in fighting off various types of corruption? Do these instruments generate any trade-off between one type of corruption and another? When does a better supervision technology mitigate corruption; and when does it not? I address these questions in a simple model where a street-level bureaucrat who is presented with an opportunity to reap a private corrupt benefit plays against a supervision system. I distinguish between external

(individual) and internal (organized) types of corruption, and thus I allow for the possibility of collusion between the supervisors and the street-level bureaucrat. I also distinguish between types of internal corruption, according to its timing (before and after detection of a bribe) and according to the crime involved. I consider two types of potential crimes for the bureaucrat: a rather trivial case of bribe for (say, speeding up) a legal application; and a bribe for processing an illegal application. I compare the effectiveness of two supervisory procedures in light of these distinctions. Under “integrated supervision,” review and active monitoring are performed by the same agent; under “separated supervision,” they are performed by two distinct agents.

Formal studies of corruption in organizations build on two branches of literature, the economics of crime and law enforcement, and principal–agent relationships. I borrow from Becker (1968) the basic idea that incentives to engage in crime depend on the expected rewards and, because crime is inherently risky, the probability of being caught and convicted. Becker and Stigler (1974) were first to introduce a principal–agent model of corruption; Banfield (1975) and Rose-Ackerman (1978) have further extended their analysis. The major development in the second branch of literature that is relevant here is the extension of the classic principal–agent framework to include chains of principal–agent relationships, with pioneering papers by Tirole (1986, 1992) and Laffont (1990). The new principal–supervisor–agent paradigm stimulated many papers exploring various aspects of private organizations with possible collusion among the members.¹ However, existing models of private organizations shed little light on the corruption problem, owing to the differences and complexities of public bureaucracies.² Cadot (1987) discusses bribery but does not consider the problem of internal corruption. Basu et al. (1992) come closest to our analysis in that they consider the possibility of internal bribery. None of these papers endogenize the supervision system; they thus step aside the problem of motivating the supervisors. They treat the act of bribery as a homogeneous crime, and hence they do not allow for partial collusion. Nor do they distinguish between *ex-ante* and *ex-post* occasions for collusion.³

What I call *external corruption* is an individual, isolated act of corruption that occurs in the transaction between the client and the street-level bureaucrat. Typical examples are extortion and bribes. *Internal corruption*, on the other hand, is a form of collusion transforming the organization into an internal market of systematized sharing of corrupt proceeds.⁴ Clearly, a public organization with full internal corruption will exhibit full external corruption. To cope with external corruption the organization may implement active monitoring and hierarchical review, but these measures can easily

¹See, for example, Kofman and Lawarrée (1993).

²The major difference between public and private organizations lies at the level of objectives; public organizations lack clear goals. This, of course, has implications for the incentives (see also note 10). Economic theorists’ limited attention to the study of decision making, supervision, and enforcement in public bureaucracies and government has recently been emphasized by Tirole (1994); his paper is rich in ideas for future theoretical research in this field.

³Manion (1996) and Bac (1996a, 1996b) include most of these features but do not distinguish between legal and illegal applications, hence they do not address the impact of supervision and review systems on the control of corruption.

⁴Examples of internal corruption in public bureaucracies abound. In his case study of corruption in the Hong Kong police force during the 1960s and 1970s, Klitgaard (1988) reports that officials collected money from drug and gambling dens, a sizeable sum of which was transferred to higher ranking officials. He writes: “About HK\$65,000 was collected each month in this fashion, and the sum was divided in an organized and hierarchical way,” ranging from HK\$50 for a constable to the sizeable sum of HK\$4000 for the senior superintendent. Another—rather extreme—example of internal corruption is reported by Morris (1991) in Mexico, where a group of police in 1983 was discovered operating a large auto theft and bank robbery ring.

backfire if they generate a scope for internal corruption. There are, of course, degrees of internal corruption, according to the scope and coverage of the collusive agreement. The organization may only exhibit *partial* internal corruption involving certain types of corrupt actions; for example, the supervisors may be internally bribed for not reporting specific types of bribes. I will show that such partial internal corruption occurs *ex-post* (upon detection), whereas *full* internal corruption occurs *ex-ante*.

From the legal point of view, there is no well-defined standard crime of corruption.⁵ Formal and informal sanctions that apply, for instance, to a bribe for speeding up the process of paying taxes differ substantially from those for the rather blatant crime of accepting bribes for an illegal land sale. I assume differential sanctions for the two types of crimes. Breaking the crime of corruption into its elements, I investigate the impact of sanctions, supervisory rewards, and review procedures on the incentives to accept a bribe for a client's *legal* or *illegal* application.⁶

Two variants of a two-stage approval/rejection supervision procedure are studied. The first stage consists of active monitoring of the street-level bureaucrat; in the second stage the application is reviewed. The probability of detection in both monitoring and review stages of supervision is endogenous. The review process checks the legal status of the application, thus a bribe on a legal application can be detected only through monitoring. The integrated supervision procedure has a single supervisor who works in both stages, i.e., who monitors and reviews the street-level bureaucrat. The separated supervision procedure has two supervisors; the second reviews the decision made by the first, who in turn monitors the street-level bureaucrat.

The paper presents a set of results that hold under both supervision procedures, concerning the impact of sanctions and rewards on monitoring, review, and expected level of corruption. Bureaucracies that provide higher rewards to their supervisors will induce closer supervision and lower levels of all types of corruption. Higher penalties have no direct impact on supervision incentives but produce a similar desirable effect on external corruption. However, higher penalties increase the bureaucrat's willingness to pay for safely accepting bribes, and hence they enlarge the scope for all types of collusion, *ex-post*, *ex-ante*, partial, and full. Excessively high penalties can thus generate full internal (hence, external) corruption, quite the opposite of what conventional wisdom suggests.

The second set of results concerns the comparative effectiveness of the two supervision procedures in deterring corruption. I find that the separated supervision procedure is more effective in reducing external corruption but displays a larger scope for *ex-ante* full internal corruption. The choice of the supervision procedure, as for that of the penalties, presents a delicate trade-off. Separating review from active monitoring (assigning review of applications to a second supervisor) generates an externality in the system: It brings in the possibility of punishing the first supervisor if he fails to detect an illegal application detected by the second. It also induces competition between the supervisors for the reward from a successful bribe report on an illegal application. As a result, monitoring incentives are much stronger and expected *external* corruption is

⁵In the words of a legal scholar, Lowenstein (1985), "... the crime of bribery is the core of a series of concentric circles representing the degrees of impropriety in official behavior." See also Ruff (1977) for problems caused by definitional difficulties in the enforcement of corruption laws.

⁶To my knowledge, the only theoretical study that draws the "legal/illegal application" distinction is Rose-Ackerman (1978). Though she provides a thorough analysis of the pros and cons of corruption based on economic first principles, her analysis lacks a rigorous game-theoretic framework.

lower under the separated supervision procedure. However, given the potential benefits from collusion, the same externality reduces equilibrium payoffs in the system and makes *internal* corruption more attractive. Introducing sequential competition in supervision may thus generate higher (indeed, full) corruption instead of reducing it. The trade-off between external corruption and the risk of internal corruption should be an important consideration in choosing between integrated/separated supervision procedures. This choice bears a further, practical importance because other parameters (rewards, penalties) that ideally should be adjusted to mitigate internal corruption in public bureaucracies are not fully adjustable.

I identify three potential cases of partial internal corruption that occur upon detection if the supervisor's reward from reporting falls short of the offer (or the bargained transfer) he receives for covering up the bribe. The surplus that can be shared in turn depends on the sizes of bribes and potential penalties. For a bribe from a legally qualified applicant that is detected during the monitoring process, the two supervision procedures produce the same collusion-proofness constraint: The lower the supervisor's reward, or the larger the bribe and the penalty, the higher is the risk of *ex-post* collusion. There are two cases of *ex-post* partial internal corruption upon detection of an illegal application. If detection occurs during the monitoring process, collusion between the bureaucrat and the supervisor is less likely under the separated supervision procedure because the application will be reviewed by the second supervisor. On the other hand, the integrated supervision procedure is less likely to generate collusion upon detection in the review process. The reason is simple: Only the street-level bureaucrat can be punished under the integrated procedure, as opposed to two officials (the bureaucrat and the first supervisor) under the separated procedure. Obviously, the two officials together can offer a larger bribe to cover up the detected crime.

The next section describes the model and discusses its basic features. Sections III and IV study respectively the noncooperative equilibria and internal corruption possibilities under the integrated supervision procedure. Sections V and VI examine the separated supervision procedure and contrast the results with those of Sections III and IV. Section VII concludes.

II. A Model of Public Bureaucracy

I consider two variants of a simple model of public bureaucracy with risk-neutral individuals. The first is the star hierarchy, which includes two individuals, a street-level bureaucrat called the agent (*A*) and a supervisor (*S*) who performs two tasks: active monitoring and reviewing. The second hierarchy is called the hat hierarchy, where review and active monitoring are done separately by two supervisors. The two supervisory functions are thus "integrated" in the star hierarchy and "separated" in the hat hierarchy. I begin with a description of the sequence of events in the star hierarchy; the corresponding game tree (excluding the possibility of *ex-ante* collusion) is depicted in Figure 1.

In the first stage of the supervision game agent *A* meets a client whose application can be of two types: a legal application with probability α and an illegal application with probability $1 - \alpha$. Only the agent observes the legal status of the application, but the value of α is common knowledge.⁷ *A*'s duty is to process the legal application and to

⁷A request for a service or benefit to which the client is legally entitled is a legal application; otherwise, it is an illegal application. For example, a developer seeking approval for a structure in an urban area has a legal application if the

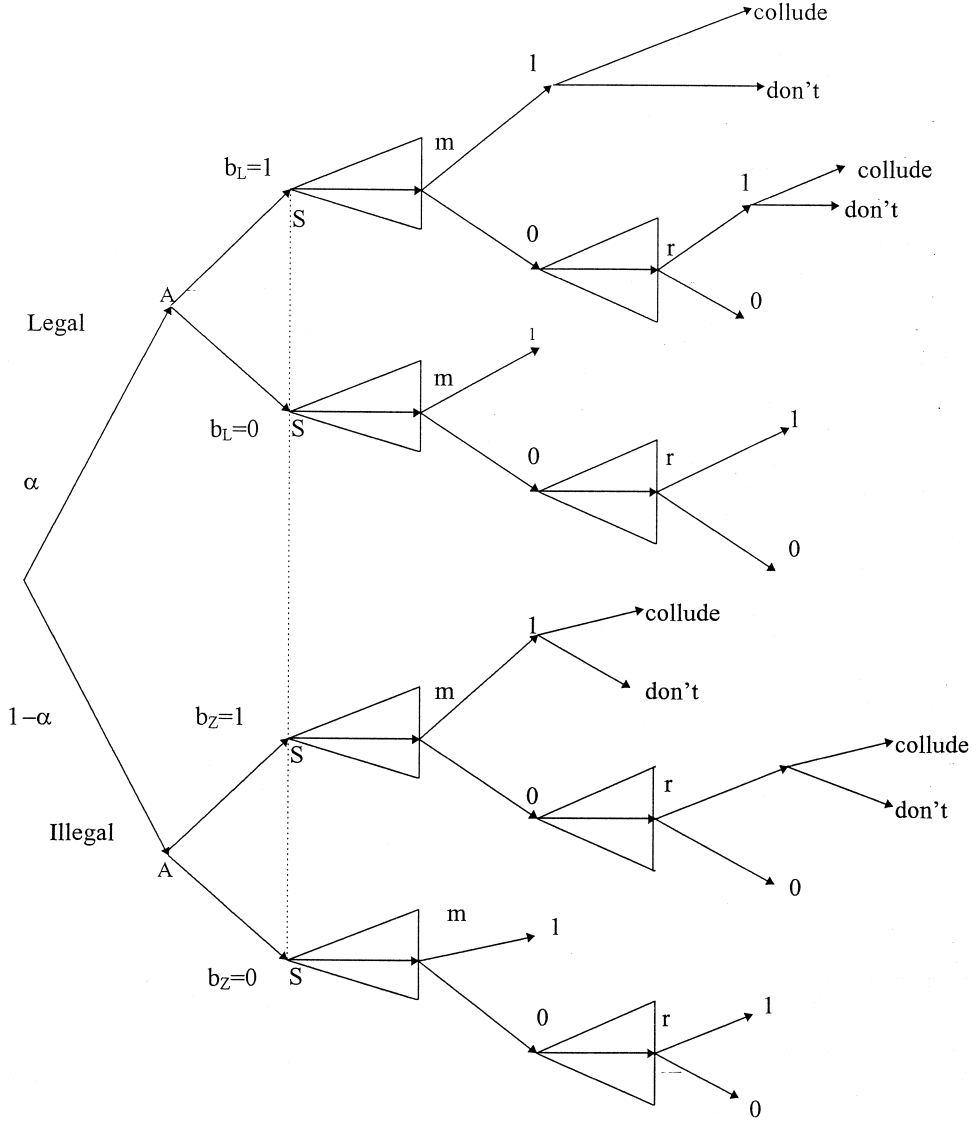


FIG. 1. The supervision game in the star hierarchy.

reject the illegal application. Instead of processing the legal application ($b_L = 0$), A may try extracting a bribe of L from the client ($b_L = 1$). Similarly, when A is presented with an illegal application, instead of rejecting it on the spot he may again try extracting a bribe, this time of value Z , for processing the application. The bribes can be interpreted

planned structure accords with the existing laws and regulations; a passport request is also a legal application if the applicant is legally qualified (e.g., citizenship, age, and criminal record). Offering a bribe for passing a prohibited good through customs is an illegal application.

as the client's maximum willingness to pay for the agent's corrupt service.⁸ I assume $L < Z$ and denote by b_Z the probability that the agent assigns to accepting this bribe.

The agent and his supervisor S first play a monitoring game: simultaneously with A 's choice of b_L or b_Z , S chooses a monitoring effort m . The marginal cost of supervision effort (be it for monitoring or review) is assumed constant for simplicity and is denoted by c . With probability $\mu(m)$, S successfully monitors A and detects the bribe if $b_L = 1$ or $b_Z = 1$ is realized. We assume that $\mu: R^+ \rightarrow [0, 1]$ is strictly concave and differentiable, with $\mu'(m) \rightarrow \infty$ as $m \rightarrow 0$.⁹ If A is caught taking a bribe for a legal (respectively, illegal) application, he is fined f_L (respectively, f_Z). On the other hand, the supervisor S obtains a reward worth p_L (respectively, p_Z) if he successfully documents a bribe for a legal (respectively, illegal) application. Detection of a bribe ends the game. A may try to bribe S to avoid the fine; an agreement to this effect is called partial *ex-post* collusion.

If monitoring fails, the game proceeds to a second stage where only S moves. S 's choice in this stage consists of a review effort r , which costs him cr . Success in review is also stochastic. With probability $\rho(r)$ review is successful, which means that S is able to see whether the application is legal or illegal. I assume that $\rho: R^+ \rightarrow [0, 1]$ is strictly concave and differentiable, with $\rho'(r) \rightarrow 0$ as $r \rightarrow 0$. If S detects and reports an illegal application, A is fined f_Z and S receives the reward p_Z . The other option for S upon his detection is to collude with A .

Multistage supervision procedures are widely used in public organizations. The two-stage procedure we have described above provides a double-checking mechanism for the illegal application, but the only occasion in which a bribe for a legal application can be detected is the first stage, through active monitoring by S . Monitoring thus should be understood as a close inspection of the agent during his decision-making process; review is an examination of the written application. Effective supervision in public organizations can be induced with the carrot of rewards for successful supervisors who report, and the stick of fines for those who fail to or deliberately do not report corrupt behavior.¹⁰ The stick can be used to the extent that alternative reliable sources of information are available. Outside whistleblowers (the clients themselves and the media) are examples of such sources. For simplicity, I assumed that the agent can safely accept bribes in the absence of supervision. I consider, however, an internal source of information. In the hat hierarchy, where review is assigned to a second supervisor, it is possible to punish the first supervisor if the second detects and reports an illegal application. As for the rewards to successful supervision, they are mostly nonmonetary in public organizations, such as improved career expectations, travel, favorable public-

⁸I have chosen not to represent the client's behavior explicitly in the model to keep the analysis simple. The relevant consideration for the client who bribes the street-level bureaucrat is the potential trouble from detection. This can be captured by lower values of L and Z in the model, for the client's expected benefit from (hence, his willingness to pay for) the bureaucrat's corrupt service is lower. Whether the organization is internally corrupt would, however, make a difference, for the client's willingness to pay because in that case the client would face no risk of detection, hence no potential trouble. The analysis would go through by assuming two different values of bribes, L_H and L_L , the first being for an internally corrupt organization and higher than L_L , the bribe when the organization displays no internal corruption.

⁹A "prime" denotes a partial derivative throughout the paper.

¹⁰Incentive systems in public organizations are relatively ineffective due to a host of reasons including difficulties involved in measuring individual performance. Consider for instance the problem of evaluating the performance of a police department. For another public organization, Wilson (1989) writes: "... prisons have rules, but the ends that these rules should serve are unclear—custody? security? self-governance, or rehabilitation?"

ity, and simple praise. In the model, these rewards are represented by p_L and p_Z . Nothing is assumed about the relative sizes of p_Z and p_L .¹¹

Besides appropriate supervisory incentives, the prevention of corruption requires punishments for illicit behavior. Public organizations' ability to raise punishments is constrained by internal regulations and the external legal environment (for example, local service laws). The list may include prison sentences and fines, or tarnishing the names of corrupt officials, which affects credit ranking, professional license, or later job prospects. But surprisingly often the only effective punishment for even a severe crime is dismissal. The model has differential punishments for the two types of crimes, for a good reason: Processing an illegal application involves, besides the incidence of bribe, an additional violation of law whose social cost is likely to be higher than a trivial speed money. In characterizing the noncooperative equilibria I will assume $Z/f_Z > L/f_L$: The bribe/fine ratio is higher for the illegal application. This assumption, to which I refer as the case of "relatively more attractive illegal application," economizes on space by reducing the number of potential noncooperative equilibria from nine to six; it has no further relevant implications.

The possibility of internal corruption is ignored below, until Section IV. Considering the star hierarchy, let w_A be A 's wage, and suppose first that he receives a legal application. If A accepts the bribe, there are two possibilities: He will be monitored successfully with probability $\mu(m)$ and fined, which yields the payoff $w_A - f_L$. If he is not detected, he gets the payoff $w_A + L$. So A 's expected payoff when he receives a legal application is

$$EU_A^*(L) = b_L[(1 - \mu(m))(w_A + L) + \mu(m)(w_A - f_L)] + (1 - b_L)w_A,$$

which simplifies to

$$EU_A^*(L) = b_L[L - \mu(m)(L + f_L)] + w_A.$$

Thus, given a monitoring effort m , A 's best reply is:

$$b_L^*(m) = \begin{cases} 1 & \text{if } \mu(m) < \frac{L}{L + f_L} \\ [0, 1] & \text{if } \mu(m) = \frac{L}{L + f_L} \\ 0 & \text{if } \mu(m) > \frac{L}{L + f_L} \end{cases}. \quad (1)$$

Acceptance of a bribe for an illegal application will go undetected with probability $(1 - \mu(m))(1 - \rho(r))$ but will be detected with probability $\mu(m) + (1 - \mu(m))\rho(r)$. This yields the expected payoff

¹¹A perhaps obvious but important difference between salaries and rewards in terms of their effect on incentives should be stressed. It is often argued that unreasonably low salaries compel the officials to be corrupt, bribes replacing pay hikes. In contrast with efficiency wage models, here a salary increase makes no difference to corrupt incentives at the margin. Salaries have an impact on the scope for internal corruption if sanctions include the loss of a job, as I show in section V.

$$EU_A^*(Z) = b_Z\{(1 - \mu(m))(1 - \rho(r))(w_A + Z) + [\mu(m) + (1 - \mu(m))\rho(r)](w_A - f_Z)\} + (1 - b_Z)w_A,$$

which simplifies to

$$EU_A^*(Z) = b_Z\{(1 - \mu(m))(1 - \rho(r))Z - [\mu(m) + (1 - \mu(m))\rho(r)]f_Z\} + w_A.$$

Hence, A's best reply $b_Z^*(m)$ to S's monitoring and review efforts can be written as

$$b_Z^*(m) = \begin{cases} 1 & \text{if } \mu(m) < K \\ [0, 1] & \text{if } \mu(m) = K \\ 0 & \text{if } \mu(m) > K \end{cases} \quad (2)$$

where $K = [Z - \rho(r)(Z + f_Z)] / [(Z + f_Z)(1 - \rho(r))]$. A's *ex-ante* (before he receives the application) expected payoff is $EU_A^* = \alpha EU_A^*(L) + (1 - \alpha)EU_A^*(Z)$.

Consider now the supervisor's two-stage decision problem. S will review only if monitoring fails. In that event, S's expected payoff from reviewing is $\rho(r)[(1 - \alpha)b_Z p_Z] - cr$. Thus, his expected payoff at the beginning of the monitoring game can be written as

$$EU_S^* = \mu(m)[\alpha b_L p_L + (1 - \alpha)b_Z p_Z - mc] + (1 - \mu(m))[(1 - \alpha)b_Z p_Z \rho(r) - (m + r)c] + w_S.$$

A noncooperative (Nash) equilibrium of the supervision game in the star hierarchy is a collection of strategies $\{b_L^*, b_Z^*, m^*, r^*\}$ defined in the obvious way. Strategies must be best replies to each other: b_L^* and b_Z^* must satisfy equations (1) and (2), respectively, whereas m^* and r^* must satisfy, respectively,

$$\mu'(m^*)[\alpha b_L^* p_L + (1 - \alpha)b_Z^* p_Z(1 - \rho(r^*)) + cr^*] = c, \quad (3)$$

$$\rho'(r^*)(1 - \alpha)b_Z^* p_Z = c. \quad (4)$$

Recall that the optimality condition for r^* in equation (4) applies only if monitoring is not successful, i.e., if $\mu = 0$ is realized (see Figure 1). I investigate below the impact of rewards and fines on the noncooperative equilibrium of the star hierarchy.

III. Equilibrium Analysis in the Star Hierarchy

The Impact of Rewards

In characterizing equilibria I assume that the illegal application is relatively more attractive. In the absence of this assumption the analysis proceeds similarly but is slightly more complex as one has to consider a larger number of potential cases. I start with a lemma:

LEMMA: *If $Z/f_Z > L/f_L$, the supervision game has no equilibria in which $b_Z^* = 0$, no matter the values of p_L and p_Z .*

PROOF: *Suppose that there is an equilibrium where $b_Z^* = 0$. By equation (4), $r^* = 0$ in such an equilibrium. The corresponding necessary conditions can be combined as*

$$\frac{L}{L + f_L} \leq \mu(m^*) \leq \frac{Z}{Z + f_Z},$$

TABLE 1. The impact of rewards on monitoring, review and corruption

	$\frac{dm^*}{dp_L}$	$\frac{dm^*}{dp_Z}$	$\frac{dr^*}{dp_L}$	$\frac{dr^*}{dp_Z}$	$\frac{db_L^*}{dp_L}$	$\frac{db_L^*}{dp_Z}$	$\frac{db_Z^*}{dp_L}$	$\frac{db_Z^*}{dp_Z}$
(1) $b_L^* = b_Z^* = 1$	(+)	(+)	0	(+)	0	0	0	0
(2) $b_L^* \in (0, 1), b_Z^* = 1$	0	0	0	(+)	(-)	(-)	0	0
(3) $b_L^* = 0, b_Z^* = 1$	0	(+)	0	(+)	0	0	0	0
(4) $b_L^* = 0, b_Z^* \in (0, 1)$	0	0	0	0	0	0	0	(-)
(5) $b_L^* \in (0, 1), b_Z^* \in (0, 1)$	0	0	0	0	(-)	0	0	(-)
(6) $b_L^* = 1, b_Z^* \in (0, 1)$	(+)	0	(-)	0	0	0	(-)	(-)

which implies $Zf_L \leq Lf_Z$ and contradicts the assumption.

Thus, ruling out $b_Z^* = 0$, the supervision game may exhibit six types of equilibria according to whether the pair (b_L^*, b_Z^*) involves combinations of pure and/or mixed strategies. Proposition 1 shows that the effect of changing p_L and p_Z on equilibrium strategies depends on the type of equilibrium; p_L is more effective in reducing b_L^* , whereas p_Z is more effective on reducing b_Z^* . I will refer to the equilibrium in case (1) of Proposition 1 as a type-(1) equilibrium, case (2) as a type-(2) equilibrium, and so forth.

PROPOSITION 1: *Comparative statics applied to equilibrium conditions are summarized in Table 1.*

The proof consists of lengthy algebraic manipulations of total differentiation of equilibrium conditions; it is omitted. I highlight below some common features of equilibria according to these comparative statics results. A small increase in the reward for detecting a bribe on a legal application induces a higher monitoring effort in equilibria where monitoring is ineffective; that is, $dm^*/dp_L > 0$ whenever $b_L^* = 1$. But when monitoring is effective ($b_L^* \in [0, 1]$), the only impact of increasing p_L is to reduce b_L^* . The equilibrium review effort r^* , on the other hand, is independent of p_L except in type-(6) equilibria where it is “crowded out” by the higher monitoring effort m^* . As for the impact of a small increase in p_Z it stimulates monitoring if supervision is ineffective on illegal applications ($b_Z^* = 1$), except in a type-(2) equilibrium where $b_L^* \in (0, 1)$. The review effort increases with p_Z if and only if $b_Z^* = 1$, and it remains constant if $b_Z^* \in (0, 1)$. Thus, in equilibria of types (4), (5), and (6), a higher p_Z causes a reduction in b_Z^* .

To provide further intuition on the workings of the model, I consider the following exercise, which consists of increasing p_Z for fixed values of p_L . To begin with, suppose that p_L is sufficiently low and $p_Z = 0$. This means, through the equilibrium conditions in equations (1) and (4), that $\mu(m^*) < L/(L + f_L)$ and $r^* = 0$, hence $b_L^* = b_Z^* = 1$: The equilibrium is of type (1), where monitoring is positive but ineffective, and the application is not reviewed. A strictly positive p_Z will activate the review process and, by part (1) of Proposition 1, both monitoring (m^*) and review efforts (r^*) will rise. Two cases may arise depending on the initial level of p_L . If p_L is low enough, higher p_Z may, through increases in m^* and r^* , eventually lead to an equilibrium in which $b_L^* = b_Z^* = 1$ with

$$\frac{Z - \rho(r^*)(Z + f_Z)}{(Z + f_Z)(1 - \rho(r^*))} = \mu(m^*) < \frac{L}{L + f_L}.$$

At this point, r^* and m^* are such that A is indifferent to a bribe for the illegal application but strictly prefers it for the legal application. The intuition is that because p_L is too low

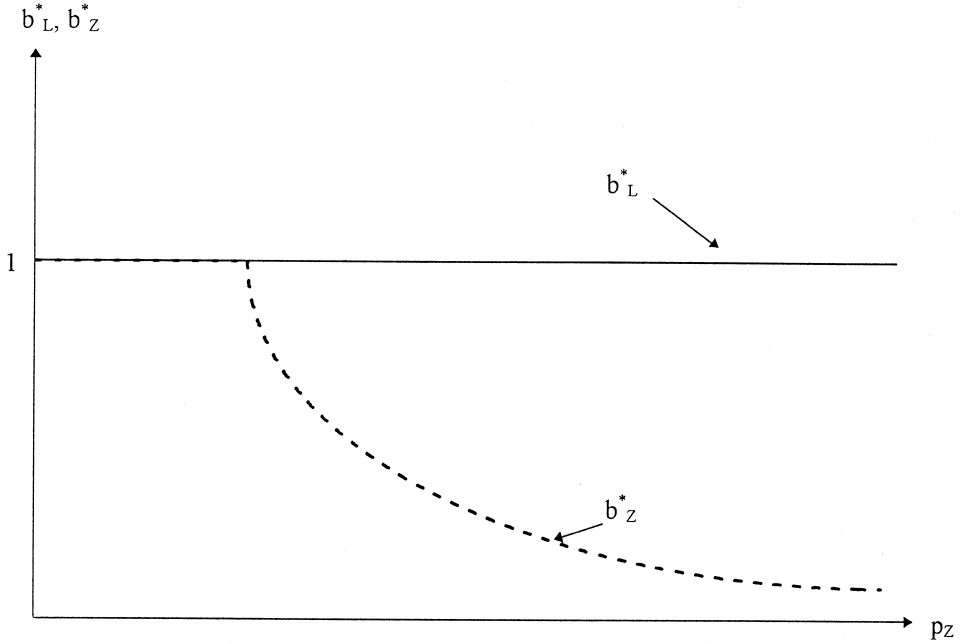


FIG. 2. The effect of the reward for detecting the illegal application when p_L is low.

with respect to p_Z S concentrates his effort on detecting the illegal application through monitoring and reviewing, as a result the equilibrium switches to a type (6). From that point on, higher p_Z will keep decreasing b_Z^* toward zero but will leave all other strategies unchanged. This case, corresponding to a low level of p_L , is depicted in Figure 2. Now, if p_L is not too low, increasing p_Z may lead to the border between type-(1) and type-(2) equilibria where $b_L^* = b_Z^* = 1$ and

$$\frac{Z - \rho(r^*)(Z + f_Z)}{(Z + f_Z)(1 - \rho(r^*))} > \mu(m^*) = \frac{L}{L + f_L}. \quad (5)$$

A becomes indifferent between $b_L = 0$ and $b_L = 1$ (chooses $b_L^* = 1$ in this particular border equilibrium), but he strictly prefers $b_Z^* = 1$. Because p_L is higher than in the case considered in Figure 2, to the same level of p_Z corresponds a higher monitoring effort that becomes effective on A 's decision about the bribe for a legal application. Increasing p_Z will switch the equilibrium to a type-(2) equilibrium where S 's optimal review effort satisfies $\rho'(r^*)(1 - \alpha)p_Z = c$ because $b_Z^* = 1$, and r^* will be increasing in p_Z . But m^* , as determined through equation (3), will not respond (see Figure 3). For if it were to respond, $\mu(m^*) > L/(L + f_L)$ would imply $b_L^* = 0$, which in turn would require m to fall dramatically by condition (3), upsetting the equilibrium. Thus, in a type-(2) equilibrium, the only impact of a higher p_Z is to reduce b_L^* . As p_Z is increased further, r^* will keep increasing, and eventually a value of p_Z will be reached such that the three terms in equation (5) will be equal to each other. This corresponds to a type-(5) equilibrium where A hesitates between accepting and rejecting both types of applications. Thereafter, increasing p_Z will only decrease b_Z^* as depicted in Figure 3. Another possibility that

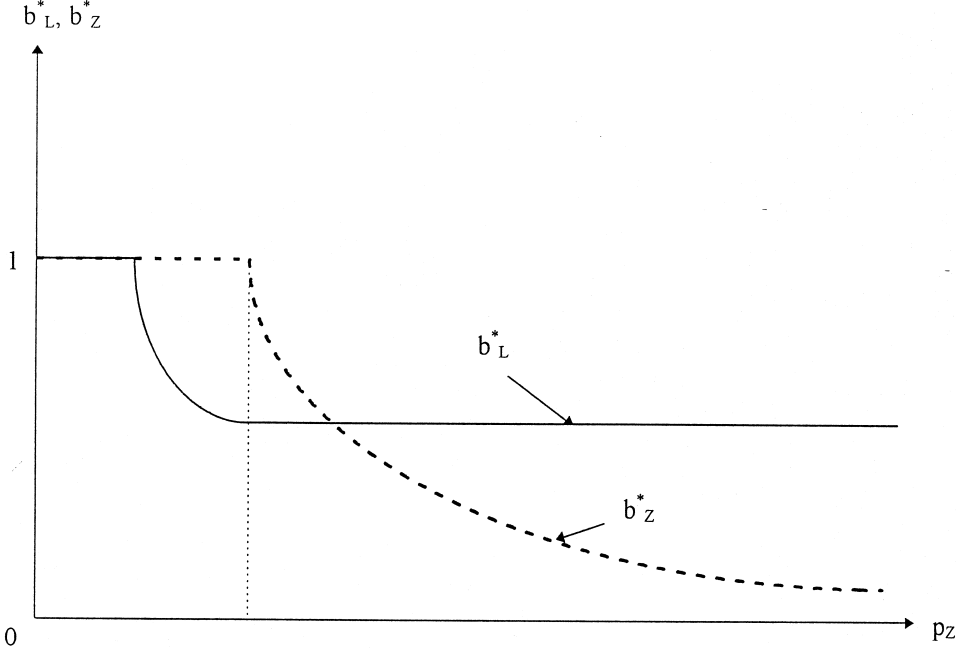


FIG. 3. The effect of the reward for detecting the illegal application when P_L is large.

may arise if p_L is initially set sufficiently high is that b_L^* may fall to zero before b_Z^* becomes mixed. In this type-(3) equilibrium, an increase in p_Z generates increases in both m^* and r^* and the equilibrium will at last switch to a type (4). This case is shown in Figure 4.

The integrated two-step supervision procedure with high rewards to successful supervision will thus exhibit lower external (and, as I show in Section IV, internal) corruption. In particular, the reward p_Z induces both monitoring and review efforts, and hence, it is more powerful than p_L .

The Impact of Fines

The fines affect noncooperative equilibria only if supervision is effective.

PROPOSITION 2: Consider a type-(5) equilibrium of the star hierarchy where $b_L^* \in (0, 1)$ and $b_Z^* \in (0, 1)$. In the absence of collusion:

- (1) A small increase in f_L reduces equilibrium monitoring but increases the review effort. The agent is less (more) likely to be bribed when he receives a legal (illegal) application;
- (2) A small increase in f_Z reduces both the review effort and A's willingness to accept a bribe from an illegal application. The monitoring effort and A's acceptance strategy for the legal application remain unchanged.

PROOF: Consider Part 1. Changes in f_L affect equilibria through the agent's indifference condition $\mu(m^*) = L/(L + f_L)$. Suppose that m^* does not change in response to a small increase in f_L . Then, $\mu(m^*) > L/(L + f_L)$, which implies $b_L^* = 0$, and the equilibrium condition (3) for m^* will not hold. Clearly, m^* should decrease to restore the equality $\mu(m^*) = L/(L + f_L)$. Differentiating A's indifference condition for $b_Z^* \in (0, 1)$ given in equation (2) yields

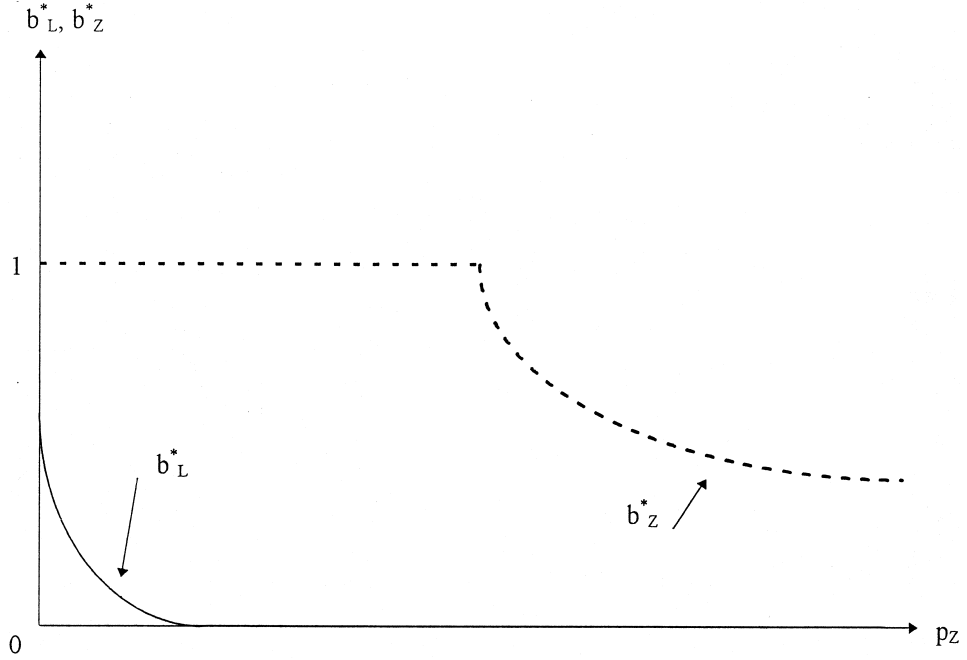


FIG. 4. The effect of the reward for detecting the illegal application when p_L is very large.

$$\mu'(m^*) dm = - \frac{\rho'(r^*)}{(1 - \rho(r^*))} (1 - \mu(m^*)) dr,$$

which shows that r^* should increase in response to the decrease in m^* . From the equilibrium condition (4) we see that b_Z^* must also increase. Using these results in equation (3), it follows that b_L^* must fall. Part 2 can be proved through similar arguments.

Though small changes in the fines f_L and f_Z affect the level of corruption only when equilibrium supervision is effective, large increases in f_L and f_Z can, of course, transform ineffective supervision into effective supervision. However, as shown below, including the possibility of internal corruption may change the picture dramatically.

IV. Internal Corruption in the Star-Hierarchy

S and A may collude on two occasions: *ex-ante*, before A receives the application, and *ex-post*, if A is caught taking a bribe. *Ex-ante* collusion eliminates accountability completely, $m^* = r^* = 0$, hence it implies full corruption, $b_L^* = b_Z^* = 1$. An obvious necessary condition for *ex-ante* collusion between A and S is that the corresponding expected surplus be positive. This condition is also sufficient if, as I assume, collusive side contracts are costless to enforce and negotiate.¹² The *ex-ante* collusion-proofness con-

¹²The way this expected surplus is shared is inconsequential to the analysis. Sufficiency of a positive expected surplus from collusion is, of course, a strong assumption, but its implications seem somewhat tangential to the main points of this paper. The magnitude of the costs involved in enforcing and negotiating collusive arrangements depends on the

straint then requires $EU_S^* - w_S \geq \alpha L + (1 - \alpha)Z - [EU_A^* - w_A]$: S 's expected utility from monitoring and reviewing must exceed A 's *ex-ante* willingness to pay for safely accepting bribes. Using the expressions for EU_S^* and EU_A^* , this constraint can be written as

$$\begin{aligned} \alpha p_L b_L^* \mu(m^*) + (1 - \alpha) p_Z b_Z^* [\mu(m^*) + (1 - \mu(m^*))\rho(r^*)] - c[r^*(1 - \mu(m^*)) + m^*] \geq \alpha L + (1 - \alpha)Z - \alpha b_L^* [L - \mu(m^*)(L + f_L)] - \\ (1 - \alpha)b_Z^* [(1 - \mu(m^*))(1 - \rho(r^*))Z - (\mu(m^*) + (1 - \mu(m^*))\rho(r^*))f_Z]. \end{aligned} \quad (6)$$

The left-hand side of equation (6) represents the expected payoff that S foregoes if he stops supervising. The expression at the right-hand side is the maximum that A is willing to pay to avoid being monitored and reviewed. It reduces to $\alpha L + (1 - \alpha)Z$ if equilibrium supervision is effective as in a type-(5) equilibrium, but A 's maximum internal bribe is lower when supervision is ineffective ($b_L^* = b_Z^* = 1$). Grouping the terms in equation (6) yields

$$\begin{aligned} \alpha[\mu(m^*)b_L^*(p_L - (L + f_L)) - (1 - b_L^*)L] + (1 - \alpha)b_Z^*[\mu(m^*) + (1 - \mu(m^*))\rho(r^*)] \\ (p_Z - (Z + f_Z)) - (1 - \alpha)(1 - b_Z^*)Z - c[r^*(1 - \mu(m^*)) + m^*] \geq 0, \end{aligned} \quad (7)$$

which is more useful for comparing *ex-ante* and *ex-post* collusion possibilities. There are two collusion-proofness constraints for *ex-post* collusion because S may detect two types of crimes: a bribe for a legal and a bribe for an illegal application. These constraints are:

$$p_Z \geq Z + f_Z \quad (8)$$

for the case of an illegal application, and

$$p_L \geq L + f_L \quad (9)$$

for the case of a legal application. Both constraints represent the same idea: to avoid *ex-post* collusion, S 's reward must exceed the cost A incurs if S reports the bribe. I refer to the case where both equations (8) and (9) fail as *full ex-post* internal corruption, as opposed to *partial ex-post* internal corruption, which may occur when only equation (8) or (9) fails. Observe that it is impossible to have full *ex-post* internal corruption if the *ex-ante* collusion-proofness constraint (7) holds. This is intuitive, because if full collusion *ex-post* were beneficial, S would collude *ex-ante* and avoid the supervision costs.

Consider now a star hierarchy that exhibits partial *ex-post* internal corruption, and suppose that equations (7) and (8) hold but equation (9) does not. Note that equation (7) may hold even though $p_L < L + f_L$ provided that p_Z is sufficiently high and/or A is unlikely to receive a legal application (if α is low). Under these conditions, *ex-ante* collusion may not be beneficial but S may prefer colluding with A *ex-post* upon detection of the bribe L . Let $X \in [p_L, L + f_L]$ denote the internal bribe from A to S if A is caught taking the bribe L . When the star hierarchy exhibits this type of partial *ex-post* collusion, the equilibrium strategies are modified as follows: By partial collusion, $b_L^* = 1$. The monitoring effort m^* is again determined through equation (3) where the internal bribe X that S expects from A should replace p_L , whereas r^* and b_Z^* are determined, respectively, through equations (4) and (2), as

context; obviously, internal corruption can be mitigated if these costs are sufficiently high. See Tirole (1992) for a detailed discussion of this assumption in the analysis of collusion in organizations.

before. Note that m^* is now likely to be higher because $X > p_L$, inasmuch as S expects a higher private “reward” from monitoring. This indirectly increases the probability of detecting both types of bribes, hence including the bribe on an illegal application¹³ (recall that S will report such a bribe because equation (7) holds and $p_Z > Z + f_Z$ as assumed). Casual observations suggest that partial *ex-post* collusion is not uncommon. Supervisors may not report relatively “small” incidences of corruption, but instead they use the threat of it to capture a fraction of the subordinate’s private surplus. Because partial *ex-post* collusion generates closer supervision, interestingly it may even improve the efficiency of the system if the act of taking bribes from legally qualified clients has minor social costs whereas the other crime, which is now less likely to occur, has a potentially large social cost.

The second case of partial *ex-post* internal corruption is the opposite of the first: Equations (7) and (9) hold while equation (8) fails. In terms of the parameters of the model, this is likely to occur if α is close to one and/or p_Z is relatively low with respect to p_L . Because $p_Z < Z + f_Z$, there is scope for a mutually beneficial agreement according to which S receives a transfer from A for covering up a detected bribe. Let $Y \in [p_Z, Z + f_Z]$ denote the size of this transfer. Equilibrium strategies under this type of partial *ex-post* collusion are $b_Z^* = 1$; m^* is determined by equation (3) where $b_Z^* = 1$, whereas b_L^* and r^* are determined, respectively, through equations (1) and (4). Y replaces p_Z in these conditions. Notice again that the incentives to monitor and review are both enhanced by partial *ex-post* internal corruption. In the resulting equilibrium, A is less likely to accept and S is more likely to detect a bribe from a legal application.

Do better supervision technologies in the star hierarchy mitigate *ex-ante* internal corruption? Consider an improvement in the monitoring and review technologies as a shifting up of the $\mu(\cdot)$ and $\rho(\cdot)$ functions so that detection probabilities are uniformly higher, or as a decrease in c , the marginal cost of supervision effort. The first-order effects on equation (7) are, respectively,

$$\alpha b_L^*(p_L - (L + f_L)) + (1 - \alpha)b_Z^*(p_Z - (Z + f_Z))(1 - \rho) + cr \quad (10)$$

for an increase in μ , $(1 - \alpha)b_Z^*(1 - \mu)(p_Z - (Z + f_Z))$ for an increase in ρ , and $r(1 - \mu) + m$ for a decrease in c . Hence, a reduction in c has an unambiguous, desirable effect on internal corruption. Inspecting the other two first-order effects on equation (7) reveals that if the rewards p_L and p_Z are sufficiently high so that the organization does not display full *ex-post* (hence, *ex-ante*) collusion, improving the supervision technologies can only narrow the scope for *ex-ante* internal corruption. That is, in a collusion-free star hierarchy better supervision technologies have unambiguously beneficial effects. Note, however, that the sign of equation (10) is ambiguous when the hierarchy exhibits partial *ex-post* internal corruption.

Improvements in the supervision technologies have no impact on the scope for partial *ex-post* internal corruption. The conditions (8) and (9) depend only on rewards, fines, and bribes. Therefore, the intention to reduce corruption through improvements in supervision technologies may still be defeated by *ex-post* collusion; these simply may be increasing the rents that S will capture by colluding with A *ex-post*. Furthermore, if the

¹³This result can be linked to a recent result by Shavell (1992) and Wilde (1992) in the context of optimal law enforcement: Legalization of the less harmful acts (which corresponds here to allowing for partial *ex-post* collusion) reduces the cost of deterring the greater harms (here, acceptance probability of an illegal application).

improvements concern only the review technology, they may even convert a partial *ex-post* collusion into full *ex-ante* collusion. To see this possibility, consider the first-order effect $(1 - \alpha)b_Z^*(1 - \mu)(p_Z - (Z + f_Z))$, which is negative if $p_Z < Z + f_Z$ i.e., if the partial *ex-post* collusion constraint does not hold for the illegal application. Hence, a better review technology may even reverse the sign of the expression in equation (7), from positive to negative. The intuition is simple: When $p_Z < Z + f_Z$ increasing the probability of detecting a bribe for an illegal application also increases the weight of $Z + f_Z - p_Z$ in the *ex-ante* net surplus from full collusion, and as a result this net surplus may become positive.

Consider now the impact of fines on the scope for internal corruption. Section III has shown that increasing the fines f_L and f_Z will reduce external corruption. But the collusion-proofness constraints (7), (8), and (9) reveal that higher fines will unambiguously increase the risk of internal corruption, *ex-ante* and *ex-post*. In the noncooperative equilibrium, A is less likely to accept bribes when fines are increased, which in turn decreases the expected rewards from successful supervision. This means that it is easier to bribe S for collusion. Because A is willing to pay more to avoid the potential higher fines, the case for collusion is unambiguously stronger. This brief discussion on fines generates important insights about two popular propositions on the prevention of corruption. First, it is not true that higher sanctions will mitigate corruption; they may even increase corruption by transforming its type from external to internal. Second, if, as is often the case in the public service, the only sanction that can be imposed is dismissal, we can reformulate this result as: Higher wages *per se* will reduce external corruption but will increase the likelihood of internal corruption.

It should be clear that the safest instruments in fighting off corruption are the rewards to successful supervision. High values of p_L and p_Z generate equilibria with effective monitoring, review, and lower external corruption. Also, both *ex-post* and *ex-ante* collusion-proofness constraints are more likely to hold under higher rewards, thus the possibility of internal corruption can be completely eliminated. If p_L and p_Z are fully flexible (which, unfortunately, hardly obtains in the case of public bureaucracies), the good news is that no trade-off is involved in the combat against internal and external types of corruption through the use of these instruments.

V. Separation of Review and Monitoring: The Hat Hierarchy

This section studies an alternative supervision procedure, which consists of a three-rank hierarchy with three individuals, A , S , and R . The first supervisor S is now at the middle rank of the hierarchy, and his task is limited to monitoring the bottom-rank agent A . Review is performed by the second supervisor, denoted R (reviewer). I call this organization the hat hierarchy.

The game is as described in Section II, except that monitoring and review are done separately by S and R . This separation presents a new possibility for the incentive system: punishing S (and A , of course) if R uncovers an illegal application. I assume that the fine f_Z is imposed on both A and S if R demonstrates that an illegal application is accepted.¹⁴ Recall that the review process cannot detect a bribe for a legal application.

Expected payoffs in the hat hierarchy are as follows. The expression for the bottom-rank agent A 's payoff is as in the star hierarchy:

¹⁴This assumption is inconsequential to my results and economizes on notation. The reader may consider differential fines for A and S .

$$\begin{aligned}\widehat{EU}_A = & \alpha b_L[L - \mu(m)(L + f_L)] + (1 - \alpha)b_Z[Z - \rho(r)(Z + f_Z)] \\ & - \mu(m)(1 - \rho(r))(Z + f_Z) + w_A.\end{aligned}$$

R 's expected reward from reviewing is $\rho(r)(1 - \alpha)(1 - \mu(m))p_Z b_Z$ *ex-ante* (at the outset of the supervision game) and $\rho(r)(1 - \alpha)p_Z b_Z$ *ex-post*, (if S 's monitoring fails and R receives the application). S has no incentive to misreport the outcome of his monitoring if he does not collude with A . If S reports, he gets the reward p_L or p_Z if his monitoring fails, he approves and sends the application to R . R 's expected payoff in that stage (*ex-post*) is

$$\widehat{EU}_R = \rho(r)(1 - \alpha)p_Z b_Z - cr + w_R,$$

and S 's expected payoff at the outset of the monitoring game is

$$\begin{aligned}\widehat{EU}_s = & \mu(m)[\alpha b_L p_L + (1 - \alpha)b_Z p_Z] - (1 - \mu(m))(1 - \alpha)b_Z \rho(r) f_Z \\ & - cm + w_s.\end{aligned}\tag{11}$$

The expected payoff in equation (11) shows that S 's monitoring incentives are stronger in the hat hierarchy thanks to (1) the fine f_Z for an illegal application that R may detect, and (2) the fact that monitoring is now the only means by which S can obtain the reward p_Z (as opposed to monitoring *and* review in the star hierarchy). Hence, even if S is not punished for A 's illicit behavior, S still has stronger incentives to monitor in the hat hierarchy because of (2).

The noncooperative equilibrium is denoted $\{\hat{b}_L, \hat{b}_Z, \hat{m}, \hat{r}\}$, where \hat{b}_L and \hat{b}_Z satisfy, respectively, the conditions in equations (1) and (2), replacing “stars” by “hats.” The strategies \hat{m} and \hat{r} satisfy

$$\mu'(\hat{m})[\alpha \hat{b}_L p_L + (1 - \alpha)\hat{b}_Z(p_Z + \rho(\hat{r})f_Z)] = c,\tag{12}$$

$$\rho'(\hat{r})(1 - \alpha)p_Z \hat{b}_Z = c.\tag{13}$$

As in the star hierarchy, keeping the assumption $Z/f_Z > L/f_L$, we have six potential types of noncooperative equilibria, and all the comparative statics results in Propositions 1 and 2 on the effects of changes in rewards and fines carry over here. The following proposition compares the two hierarchies.

PROPOSITION 3:¹⁵ *Given an incentive scheme that does not generate internal corruption in the two hierarchies, $b_L^* \geq \hat{b}_L$, $b_Z^* \geq \hat{b}_Z$, $m^* \leq \hat{m}$, $r^* \geq \hat{r}$.*

That is, monitoring is more intensive in the hat hierarchy than in the star hierarchy, which in turn tends to partially crowd out the review effort. However, assuming away internal corruption, expected external corruption is lower in the hat hierarchy. The next section provides further comparative results by including the possibility of internal corruption.

VI. Internal Corruption in the Hat Hierarchy

Internal corruption possibilities are slightly more complex in the hat hierarchy, owing to the presence of a second supervisor. *Ex-ante* collusion is not beneficial if total

¹⁵The proof is available from the author upon request.

expected equilibrium payoffs generated by supervision exceed the maximum that the subordinates are willing to pay to avoid being supervised. Put in another way, the expected size of the bribe that A will receive, $\alpha L + (1 - \alpha)Z$, must not exceed the sum of expected payoffs net of wages in the noncooperative equilibrium:

$$[\widehat{EU}_R - w_R] + [\widehat{EU}_S - w_S] + [\widehat{EU}_A - w_A] \geq \alpha L + (1 - \alpha)Z. \quad (14)$$

Comparing the constraint in equation (14) with the collusion-proofness constraint in the star hierarchy generates the following result:

PROPOSITION 4: *There is wider scope for full (ex-ante) internal corruption in the hat hierarchy than the star hierarchy.*

PROOF: *The expression of R 's expected payoff net of w_R in the hat hierarchy is $\widehat{EU}_R - w_R = (1 - \mu(m))[\rho(r)(1 - \alpha)p_Z b_Z - cr]$. $\widehat{EU}_S - w_S$ is given in equation (11), and the expression of $\widehat{EU}_A - w_A$ is identical to $EU_A^* - w_A$. Adding up the terms at the left-hand side of equation (14) and comparing them with $[EU_S^* - w_S] + [EU_A^* - w_A]$, shows that total expected payoffs in the noncooperative equilibria of the hat hierarchy is lower than in the star hierarchy by $(1 - \mu(m))(1 - \alpha)b_Z \rho(r)f_Z$, which is the expected cost to S if an illegal application is detected by R . The set of feasible equilibrium payoffs in the hat hierarchy is contained in the corresponding set for the star hierarchy. Because the expected surplus to be shared through collusion is the same and equal to $\alpha L + (1 - \alpha)Z$, the fact that total expected payoffs is smaller in the hat hierarchy implies that it displays a wider scope for full internal corruption.*

Thus, as in the choice of fines, a trade-off is involved in the choice of the supervision procedure. Separating the two supervision functions may reduce external corruption at the higher risk of full *ex-ante* internal corruption.

Comparing the two hierarchies in terms of *ex-post* collusion possibilities is relatively easy. When S detects a bribe for a legal application, he will report it if the reward p_L exceeds the maximum bribe A is willing to pay, i.e., if $p_L \geq L + f_L$, which is exactly the corresponding condition (9) in the star hierarchy. If S successfully monitors A while taking a bribe for processing an illegal application, by not reporting S foregoes the reward p_Z . Moreover he will be fined f_Z if R detects and reports it. Thus, S will report unless if he is paid at least $p_Z + \rho(\hat{r})f_Z$. But A 's willingness to pay to avoid being reported is now $(Z + f_Z)(1 - \rho(\hat{r}))$. Hence, the *ex-post* collusion-proofness constraint is

$$p_Z + \rho(\hat{r})f_Z \geq (Z + f_Z)(1 - \rho(\hat{r})). \quad (15)$$

Comparing equations (8) and (15) reveals that a collusion between S and A upon detection of an illegal application is less likely in the hat hierarchy. The separation of review and monitoring plays the key role in this result. Equation (15) is more likely to hold if the reward p_Z is higher, if the review technology is better, and if the bribe Z is small. The impact of f_Z is ambiguous; if the detection probability in the review process is high, increasing the fine f_Z will reduce the surplus from a partial *ex-post* collusion between S and A .

The last opportunity for *ex-post* collusion involves all three individuals, upon R 's detection of an illegal application. R 's reward if he reports is again p_Z , but A and S together are willing to bribe R up to $Z + 2f_Z$. Hence,

$$p_Z \geq Z + 2f_Z \quad (16)$$

must hold for R to report the illegal application. Comparing equations (16) and (8) reveals that the case for *ex-post* collusion is stronger in the hat hierarchy when the illegal application is uncovered during the review process.

PROPOSITION 5: *Collusion between S and A upon S 's detection of a bribe for a legal application is equally likely in both hierarchies. Ex-post collusion in the hat hierarchy (involving S and A) is less likely than the star hierarchy if a bribe from an illegal application is detected by S in monitoring, more likely (involving A , S and R) if it is detected by R in review.*

The final set of results concerns the impact of improving supervision technologies on the scope of *ex-ante* full internal corruption. As in the star hierarchy, a reduction in c (supervision costs) narrows the scope for *ex-ante* collusion. Consider an increase in the probability of detection at all effort levels. Substituting for the expressions in the collusion-proofness constraint $\sum_i (\widehat{EU}_i - w_i) \geq \alpha L + (1 - \alpha)Z$, $i = A, S, R$, an increase in μ generates the first-order effect

$$\alpha \hat{b}_L [p_L - (L + f_L)] + (1 - \alpha) \hat{b}_Z [(p_Z + \rho f_Z) - (1 - \rho)(Z + f_Z)] - [(1 - \alpha) p_Z \hat{b}_Z \rho - c \hat{r}].$$

The first two terms above represent the first-order changes in the payoffs of A and S ; they are positive if the partial *ex-post* collusion-proofness constraints (9) and (15) hold. The last term is nothing but R 's *ex-post* payoff (once he receives the application); it is preceded by a negative sign because the bribe Z is now more likely to be detected by S through the better technology, which reduces R 's *ex-ante* payoff. Combining the last two terms, the first-order effect of an increase in μ can be written as

$$\alpha \hat{b}_L [p_L - (L + f_L)] + (1 - \alpha) \hat{b}_Z [(1 - \rho)(p_Z - (Z + f_Z)) + \rho f_Z] + c \hat{r}. \quad (17)$$

As in the star hierarchy, when the rewards p_L and p_Z are too low, a better monitoring technology can only increase the potential benefits from *ex-ante* collusion. Otherwise, equation (17) is likely to be greater than equation (10) because of the additional term ρf_Z . An improvement in the monitoring technology is likely to have a more favorable effect on *ex-ante* collusion possibilities under the separated supervision procedure. Intuitively, the better technology reduces the externality on S caused by introducing R for the review. By increasing S 's probability of detecting the bribe and being rewarded (hence, decreasing the probability that S will be punished), the better monitoring technology increases S 's payoff in the noncooperative equilibrium. As a result, S is less likely to participate in a collusive agreement under a better monitoring technology.

An improvement in the review technology has the first-order effect

$$(1 - \alpha)(1 - \mu) \hat{b}_Z p_Z - (1 - \alpha)(1 - \mu) \hat{b}_Z [Z + 2f_Z] \quad (18)$$

on the scope for full *ex-ante* internal corruption. The first and the second terms in equation (18) represent, respectively, the (first-order) increase in R 's payoff and the decrease in A 's and S 's combined payoffs. Payoffs at the bottom end of the hat hierarchy are lower because A and S are now more likely to be punished for approving an illegal application. Equation (18) can be written as

$$(1 - \alpha)(1 - \mu) \hat{b}_Z [p_Z - (Z + 2f_Z)],$$

whose sign depends on the partial *ex-post* collusion constraint (16). An improvement in the review technology increases the scope for full *ex-ante* internal corruption only if the

hat hierarchy exhibits partial *ex-post* internal corruption. The wisdom often expressed in popular fora, namely, that better review technologies mitigate corruption, is true otherwise, only if *ex-post* collusion upon detection of an illegal application is not beneficial. Proposition 6 below provides the comparison of the two hierarchies:

PROPOSITION 6:

1. *Better supervision technologies or lower supervision costs have no impact on ex-post collusion possibilities.*
2. *Lower supervision costs can eliminate the possibility of ex-ante internal corruption in both hierarchies.*
3. *The impact of improving supervision technologies depends crucially on whether the hierarchy displays partial ex-post collusion. A better monitoring (respectively, review) technology generating a higher probability of detection has a relatively more (respectively, less) favorable effect on the scope for internal corruption in the hat hierarchy.*

The potentially asymmetric effects of reductions in the cost of supervision effort and increases in detection probabilities stem from their differential direct effects. The first-order effect of lower supervision costs is to increase the payoff to the supervisor; the first-order effect of a higher detection probability is more complex, as it also affects the externality in the system. Replacing the supervisor with another whose cost of effort is known to be lower has thus a more predictable, favorable effect than increasing detection probabilities through improving the supervision technologies.

VII. Concluding Remarks

Klitgaard's (1988, p. 75) formula, corruption = monopoly + discretion – accountability, is perhaps the simplest display of the essentials about corruption. This paper has assumed the monopoly problem and has studied the impact of supervision procedures (which affect discretion and accountability) on the type, scope, and timing of corruption. Future research can pursue several directions from here. An important step ahead is to endogenize the incentive scheme. One direction is to study alternative policies that aim at breaking the bilateral (bureaucrat–client) monopolies in public bureaucracies. This would require explicit modeling of clients' decision making. The literature provides several conjectures about the impact of introducing competition among the bureaucrats. A common conjecture is that competition will reduce bribes from legal applications, but that the impact on illegal applications is ambiguous. It would be interesting to see how policies that enhance competition for applications affect the scope for internal corruption. Another extension is to allow for heterogeneous types (honest/dishonest) of officials. Rose-Ackerman (1978) has shown that private information about types is relevant for the impact of introducing competition because the presence of dishonest officials may attract illegal applications.

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